NORTHWESTERN UNIVERSITY | SCHOOL OF PROFESSIONAL STUDIES

PREDICT 400: Math for Modelers **Winter 2016**

Philip M. Goldfeder, Ph.D.
philip.goldfeder@northwestern.edu

Course Description

Review of fundamental concepts from calculus, linear algebra, and probability with a focus upon applications in statistics and predictive modeling. The topics covered will include systems of linear equations and matrices, linear programming, concepts of probability underlying both classical and Bayesian statistics, differential calculus and integration. This will be taught using a Just I n Time (JIT) approach.

Texts

Required:

Lial, Greenwell and Ritchey (2012). *Finite Mathematics and Calculus with Applications, 9th Ed.* New York, NY: Pearson [ISBN-13 9780321760043]

Downey, A. B. (2012). *Think Python.* Sebastopaol, Calif.: O'Reilly. [ISBN-13: 9781449330729] (No purchase necessary. Available as a free electronic download at http://www.greenteapress.com/thinkpython/ or at Amazon for purchase as either an eBook or traditional text.)

Recommended:

Lial, Greenwell and Ritchey (2012). *Student Solutions Manual for Finite Mathematics and Calculus with Applications, 9th Ed.* New York, NY: Pearson [ISBN-13 9780321746238]

Software

Python: open source and available at https://www.enthought.com/products/canopy/academic (full instructions are listed under Course Information).

My Math Lab (MML): code included with your textbook. If you purchased the book used, a code may be purchased via http://www.pearsonmylabandmastering.com/northamerica/mymathlab/ using a credit card or PayPal.

Prerequisites

None.

Learning Goals

The goals of this course are to:

- Build mathematical models.
- Interpret mathematical models.
- Evaluate mathematical models.

Evaluation

The student's final grade will be determined as follows:

- Participation 25% (100 possible points, done in Discussions)
- Weekly Problem Sets 25% (100 possible points, done in MML)
- Midterm Exam 25% (100 possible points)
- Final exam 25% (100 possible points)

Grading Scale

A = 93–100% (372–400 points)
A- = 90–92% (360–371 points)
B+ = 87–89% (348–359 points)
B = 83–86% (332–347 points)
B- = 80–82% (320–331 points)
C+ = 77–79% (308–319 points)
C = 73–76% (292–307 points)
C- = 70–72% (280–291 points)
F = 0–69% (0–279 points)

Weekly Discussion Etiquette

The purpose of the Weekly Discussion in general is to allow students to freely exchange ideas. It is imperative to remain respectful of all viewpoints and positions and, when necessary, agree to respectfully disagree. While active and frequent participation is encouraged, cluttering a Weekly Discussion with inappropriate, irrelevant, or insignificant material will not earn additional points and may result in receiving less than full credit. Frequency is not unimportant, but content of the message is paramount. Please remember to cite all sources (when relevant) in order to avoid plagiarism.

Attendance and participation is a critical part in forming a dynamic learning experience, in school as well as on the job. As a result, you are expected to participate in activities and discussions within your Weekly Discussion group. The discussion questions will be answered each week in threaded topics accessible through the weekly modules. You are expected to log on and participate actively at least four days each week. This strategy is found to be most effective in promoting success—a little every day gets the job done. It also happens to be the exact methodology required of managers—continual, lifelong, everyday learning. Except for the last session/week, you are expected to respond to the discussion question(s) each week. The first (graded) questions is directly related to the week's topics and the other is an opportunity to ask and answer questions of your own. The expectation is several quality posts per week per person. I expect these to be polished, well-structured and APA-compliant posts. Even though they are only discussions, you still must include references and check for spelling and grammar. Since you have a spell-checker built in, this should not be an onerous task.

I will be the observer/facilitator of this process and will be assessing your contributions to the topic-related discussions. I'm looking for insightful analysis, probing questions, and *constructive* suggestions to each other. Keep thinking from the perspective—how can I *add something useful?* It may be an experience you have had professionally or a quote from an article/web site you come across. If it is the latter, please do not forget to cite it properly.

Discussion feedback and grades will be provided in your grade books on Mondays after all sessions during the term.

Software

The required software for this class is Python. There are weekly study modules (found in Course Materials) that will combine the material from the text and lecture with the readings in *Think Python*. These modules will contain both sample code and problem sets that align with the other course materials (specifically, the course textbook). It is extremely important that you keep up with these – though they will not be collected or graded -- as Python will be required for both the midterm and final exams, as well as in future courses and professional situations. To assist with your understanding and learning of Python, there will also be a Python-related discussion question each week, where participation is STRONGLY encouraged. There will also be a general Python Q&A where you can ask any questions that may be arising. These areas – a well as all other Python-related questions will be answered by Matt Crowson, who is your Python Teaching Assistant. Though I strongly encourage you to ask all questions on the discussion board for all to see (as it will be a great learning experience for the entire class), Matt is also available via email at MatthewCrowson2015@u.northwestern.edu .

Weekly Problem Sets

In sessions one through nine there will be problem sets assigned using the My Math Lab (MML) software that is associated with your textbook. Doing the problems in MML allows for real-time assistance, videos and remediation where needed. If you are having problems any step of the way, we can discuss them in the 'Q & A' discussion forum and/or you have the option of contacting me through MML for help. You are encouraged to attempt as many of these problems using Python as possible.

Lectures

There are recorded lectures as well as two types of PowerPoint presentations (by Northwestern faculty and by the authors of your textbook) each week. The recorded lectures are narrated PowerPoints, which you can also view at your own pace, sans narration. All of these will be available for the duration of the course and they are located under the weekly modules.

Attendance

This course will not meet at a particular time each week. All course goals, session learning objectives, and assessments are supported through classroom elements that can be accessed at any time. To measure class participation (or attendance), your participation in threaded Weekly Discussions is required, graded, and paramount to your success in this class. Please note that any scheduled synchronous or "live" meetings are considered supplemental and optional. While your attendance is highly encouraged, it is not required and you will not be graded on your attendance or participation.

Late Work

Unless otherwise noted, all work is due on the assigned day by 11:55 PM (Central Time). This includes exams and participation in the discussions. Late work is not accepted.

One more piece of advice: do not fall behind. We cover a lot of material in this course, and falling behind is the primary reason why folks fail. To that end, you have below the due dates for the entire course. The dates are also posted in the calendar included in Canvas. It is much, much better to be ahead than behind.

Academic Integrity at Northwestern

Students are required to comply with University regulations regarding academic integrity. If you are in doubt about what constitutes academic dishonesty, speak with your instructor or graduate coordinator before the assignment is due and/or examine the University Web site. Academic dishonesty includes, but is not limited to, cheating on an exam, obtaining an unfair advantage, and plagiarism (e.g., using material from readings without citing or copying another student's paper). Failure to maintain academic integrity will result in a grade sanction, possibly as severe as failing and being required to retake the course, and could lead to a suspension or expulsion from the program. Further penalties may apply. For more information, visit www.sps.northwestern.edu/student/issues/academic_integrity.cfm .

Plagiarism is one form of academic dishonesty. Students can familiarize themselves with the definition and examples of plagiarism, by visiting <www.northwestern.edu/uacc/plagiar.html>. A myriad of other sources can be found online.

Some assignments in SPS courses may be required to be submitted through SafeAssign, a plagiarism detection and education tool. You can find an explanation of the tool at http://wiki.safeassign.com/display/SAFE/How+Does+SafeAssign+Work. In brief, SafeAssign compares the submitted assignment to millions of documents in large databases. It then generates a report showing the extent to which text within a paper is similar to pre-existing sources. The user can see how or whether the flagged text is appropriately cited. SafeAssign also returns a percentage score, indicating the percentage of the submitted paper that is similar or identical to pre-existing sources. High scores are not necessarily bad, nor do they necessarily indicate plagiarism, since the score does not take into account how or whether material is cited. If a paper consisted of one long quote that was cited appropriately, it would score 100%. This would not be plagiarism, due to the appropriate citation. However, submitting one long quote would probably be a poor paper. Low scores are not necessarily good, nor do they necessarily indicate a lack of plagiarism. If a 50-page paper contained all original material, except for one short quote that was not cited, it might score around 1%. But, not citing a quotation is still plagiarism, as is repurposing of one's own work without citation.

SafeAssign includes an option in which the student can submit a paper and see the resultant report before submitting a final copy to the instructor. This ideally will help students better understand and avoid plagiarism.

Other Processes and Policies

Please refer to your SPS student handbook at http://sps.northwestern.edu/program-areas/graduate/student-handbook.php for additional course and program processes and policies.

Course Schedule

Important Note: *Changes may occur to the syllabus at the instructor's discretion. When changes are made, students will be notified via an announcement in class and by email.*

Session 1: Review of Algebra & Intro to Linear Functions (January 4th to 10th)

Learning Objectives

After this session, the student will be able to:

- Review equations, exponents and radical expressions.
- Describe the different characteristics of linear equations.
- Create and interpret linear functions modeling real-world scenarios.
- Interpret the meanings of linear correlations and least square lines.

Course Content

Reading

Lial, Chapters R and 1 (1.1 to 1.3)

Downey, Chapter 2, Chapter 3 (3.1 to 3.3) and Chapter 8 (8.1 to 8.2)

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 1 Module in Canvas.

Assignments

Assigned in MML and Python.

Sync Session

Tuesday, January 5th at 7 PM CST. Attendance is optional. A recording of the session will be posted in class immediately following the session.

Session 2: Linear Algebra I (January 11th to 17th)

Learning Objectives

After this session, the student will be able to:

- Solve systems of linear equations using the Echelon and Gauss-Jordan methods.
- Develop an understanding of matrix addition, subtraction and multiplication.
- Understand how and why to find the inverse of matrices.

Course Content

Reading

Lial, Chapter 2 (2.1 to 2.5)

Downey, Chapter 3 (3.4 to 3.9) and Chapter 10 (10.1 to 10.12)

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 2 Module in Canvas.

Assignments

Assigned in MML and Python.

Session 3: Linear Algebra II (January 18th to 24th)

Learning Objectives

After this session, the student will be able to:

- Describe both the graphical and simplex methods of linear programming.
- Apply linear programming to real-world problems.
- Define and understand the meaning and applications of slack variables and the pivot.
- Solve maximization and minimization problems using the simplex tableau and method.

Course Content

Reading

Lial, Chapters 3 and 4

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 3 Module in Canvas.

Assignments

Assigned in MML and Python.

Session 4: Probability I (January 25th to 31st)

Learning Objectives

After this session, the student will be able to:

- Understand the different types of events.
- Calculate probabilities and conditional probabilities of different events.
- Apply the basic concepts of probability to real-world situations.
- Define dependent versus independent events.
- Understand and use Bayes' Theorem to find probabilities.

Course Content

Reading

Lial, Chapter 7
Downey, Chapter 5 (5.1 to 5.12)

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 4 Module in Canvas.

Assignments

Assigned in MML and Python.

Session 5: Probability II (February 1st to 7th)

Learning Objectives

After this session, the student will be able to:

- Explain the differences between combinations and permutations.
- Calculate permutations and combinations to solve real-world problems.
- Solve probability problems using counting principles.
- Identify and describe binomial probabilities.
- Define probability distributions.
- Calculate expected values using probability distributions.

Course Content

Reading

Lial, Chapter 8
Downey, Chapter 6 (6.1 to 6.9)

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 5 Module in Canvas.

Assignments

Assigned in MML and Python.

The Midterm Examination will be available no later than Monday, February 1st at 12.01 a.m. (Central Time) and is due Sunday, February 7th at 11:55 p.m. (Central Time). For more information, click Assignments on the left navigation panel in Canvas, and scroll to this assignment's item.

Python Sync Session

Monday, February 1st at 7 PM CST. Attendance is optional. A recording of the session will be posted in class the following day.

Session 6: Calculus I (February 8th to 14th)

Learning Objectives

After this session, the student will be able to:

- Define and calculate limits of various types of functions.
- Explain the difference between continuous and discontinuous functions and its implications.
- Calculate the rates of changes of functions over specified intervals.
- Define and derive the definition of a derivative.
- Calculate derivatives of exponential and logarithmic functions, products, quotients, sums and differences.
- Use the chain rule to calculate derivatives of composite functions.

Course Content

Reading

Lial, Chapters 11 and 12
Downey, Chapter 7 (7.1 to 7.7)

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 6 Module in Canvas.

Assignments

Assigned in MML and Python.

Session 7: Calculus II (February 15th to 21st)

Learning Objectives

After this session, the student will be able to:

- Create and interpret the graphs of derivatives.
- Identify increasing and decreasing intervals for functions.
- Use derivatives to interpret graphs of functions.
- Identify local and absolute extrema in graphs.
- Use higher derivatives to define concavity and inflection points in graphs.
- Apply extrema to real-world problems.

Course Content

Reading

Lial, Chapters 13 and 14 (14.1 to 14.2)
Downey, Chapter 8 (8.3 to 8.11)

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 7 Module in Canvas.

Assignments

Assigned in MML and Python.

Session 8: Integral Calculus (February 22nd to 28th)

Learning Objectives

After this session, the student will be able to:

- Define and obtain antiderivatives and integrals.
- Calculate integrals of exponential and logarithmic functions, products, quotients, sums and differences.
- Use integration by substitution to calculate integrals of composite functions.
- Apply integration by parts
- Understand the relationship between integrals and the area under a curve.
- Explain and apply the Fundamental Theorem of Calculus.
- Apply integrals to the solution of real-world problems.

Course Content

Reading

Lial, Chapter 15 (15.1 to 15.4)
Downey, Chapter 11 (11.1 to 11.8)

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 8 Module in Canvas.

Assignments

Assigned in MML and Python.

Session 9: Probability and Calculus (February 29th to March 6th)

Learning Objectives

After this session, the student will be able to:

- Define discrete probability function and a continuous probability distribution.
- Define a probability density function.
- Calculate the mean and variance of a probability distribution.
- Define uniform and normal probability distributions.
- Understand the connection between normal probability distributions and the normal curve.

Course Content

Reading

Lial, Chapter 18
Downey, Chapter 12 (12.1 to 12.9)

Weekly Discussion

This session you are required to participate in all threads of the session-specific Weekly Discussion forum. Your participation in both posting and responding to other students' comments are graded. For this session's discussion topics, visit the Week 9 Module in Canvas.

Assignments

Assigned in MML and Python.

Sync Session

Tuesday, March 1st from 7:00 to 9:00 PM (CST). Attendance is optional. A recording of the session will be posted in class immediately following the session.

Session 10: Final Week (March 7th to March 13th)

Learning Objectives/Course Content/Weekly Discussion

None this week.

Assignments

The Final Examination will be posted at 12:01 AM CST on March 7th and is due March 12th at 11:55 PM CST.

